EXPERIMENT 5: THE ACCELERATION DUE TO GRAVITY

REQUIRED ITEMS

pendulum with plumb, stopwatch, meter stick, protractor

applet

http://phet.colorado.edu/sims/pendulum-lab/pendulum-lab_en.html

DATE_____

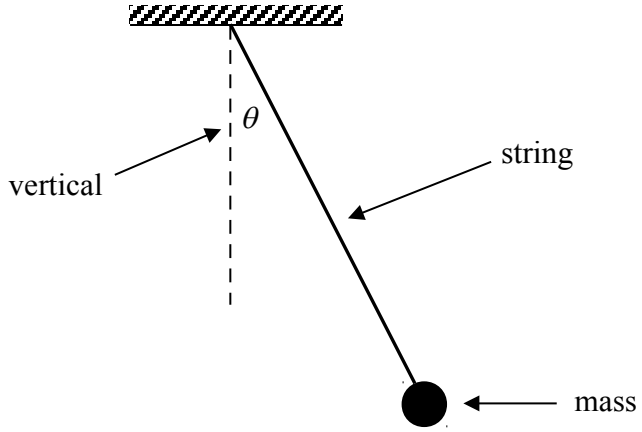
AUTHOR_____

PARTNER_____

PARTNER_____

BACKGROUND

A simple pendulum consists of a mass suspended by a cord or string. See Figure 1.



θ = angular displacement from vertical

If set in motion, in a vertical plane, the period of its motion will be independent of the amplitude of its motion for small amplitudes (initial angles measured from the vertical). The period T, is then a function only of the length L, of the string, and the acceleration due to gravity ,g:

$$T=2\pi\sqrt{\frac{L}{g}}\ .$$

This equation can be solved for g:

$$g=\frac{4\pi^2 L}{T^2}\quad or\quad T^2=\frac{4\pi^2}{g}L\ .$$

We can measure the period T and therefore T^2 for different length L. If we plot T^2 versus L we should get a line and the slope ($4\Pi^2/g$) can be used to find an experimental value of g.

PROCEDURE

STEP1:
The length L of the string is between the <u>top of the string and the center of mass</u> of the bob (steel ball or plumb). If you are using a plumb, The center of mass is indicated by a line going around the plumb. If you use a sphere instead, the center of mass is the center of the sphere. Wrap the string around the nail so the distance between the top of the string and the center of mass is about 40cm. Record the exact measure of L in the table below. (could be 39, 39.5 .. 41..) **length in cm not inches**

STEP2:
Hold the bob to one side and release it (the angle should be below 30 degrees).
Find the time t for 30 cycles. !! One cycle is a back and forth motion !!!
Record in the table below.

STEP3:
Repeat this step for about L = 60cm (25 cycles), L = 80cm (25 cycles) and L = 100cm (20 cycles).
Record in the table below.

In the table below, L is the exact pendulum length in **centimeters** not in inches.

Trial	**L** length from top to center of plumb. (x-axis)	**N** number of cycles	**t= time** for N cycles	**T = t/N** divide t by N. period is time for 1 cycle	**T^2** square the previous column. (y-axis)
----------	0	--------	----------		0
≈ 40 cm	cm	30	s	s	s^2
≈ 60 cm	cm	25	s	s	s^2
≈ 80 cm	cm	25	s	s	s^2
≈ 90 cm	cm	20	s	s	s^2

ANALYSIS

1) complete the table above.

2) Use a spreadsheet (like plot.ly).

3) Make a scatter plot ***T^2*** **(y-axis from 6th column) versus *L (x-axis from 2nd column)***. Note that the first point is (0,0).

4) Trace the best fit line. Show the equation of the line on the graph. y= ___ x .

5) slope of the line _____ s^2/cm. Y

4) The slope is $4\Pi^2/g$ (see INTRO) . Therefore:
$g_{experimental}$ = $4\Pi^2$/(slope) = _____ (g is the acceleration due to gravity).
(multiply 4 by (Π^2) and divide by the slope)

This is your experimental value for g.

6) The true value for g is 980cm/s/s (or 9.8m/s/s)
Find the % error = [(true – experimental) / true] x 100

CONCLUSION:
- A statement of the goals of the experiment (don't just copy. Use your own words).
- A description of the apparatus and equipment used in the experiments- A brief description of the measurements procedures
- Was the purpose of this lab accomplished ? Why or Why not ? So what did you find out? State the results. (your answer to this question should show thoughtful analysis and careful, through thinking)
- What are the ways to improve the experiment